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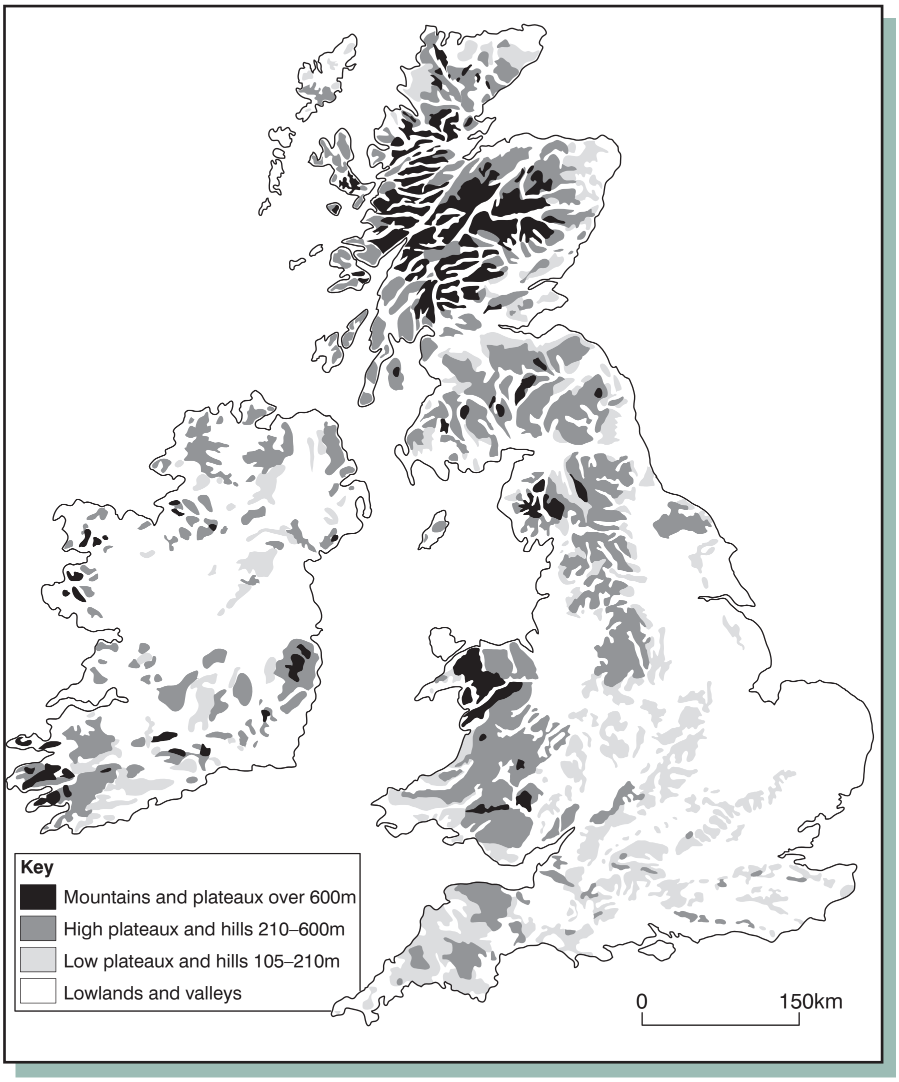
GLACIAL EROSION IN LOWLAND AREAS

The study of glacial erosion is frequently limited to an appreciation of its effects in upland areas. With spectacular features such as corrie basins and over-deepened valleys, students can readily appreciate both the magnitude of the processes that created these landforms and their impact on the landscape.

Lowland areas tend to be characterised by depositional features such as drift. The assumption therefore is that lowland erosion is not sufficiently important to be worthy of greater consideration, either because its effects are hidden beneath a mantle of deposited material, or because erosion was much less vigorous in the lowlands. This view has been questioned by, among others, D. Jones (1985): 'the significance of the Pleistocene ice-sheets in fashioning lowland areas is equally great [as in upland locations], even though it is often less conspicuous'.

This unit seeks to unravel the evidence for lowland erosion and to assess its impact through case studies.

Figure 1: Distribution of relief regions



Source: Adapted from Goudie and Brunsden (1994).

Uplands and lowlands

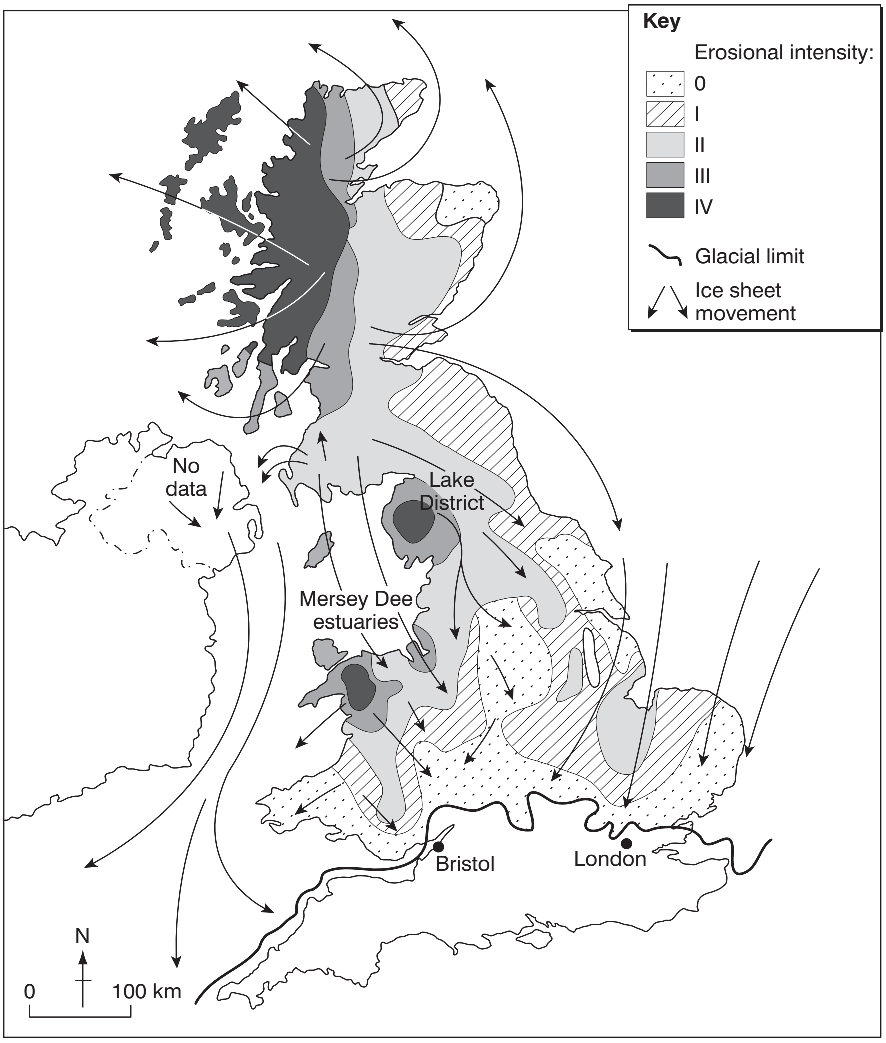
Figure 1 shows a simple division into four categories, the aim of which is to produce a clear picture of the elevation of the British Isles. Broadly, heights decline from mountains and plateaux over 600 metres in Scotland and Wales, to high plateaux and hills in the Southern Uplands, northern and southern Ireland, the Pennines, North York Moors, central Wales and Dartmoor. East and south of this, the land drops quickly away to the low plateaux of the Midlands, the scarplands and the low country of the Fens. Central Ireland too is a low depression.

This classification should make distinction between uplands and lowlands straightforward and lead us to some general expectations about the glacial landforms to be found. Nonetheless, there can be difficulties with following such a simple rule. For example, the Three Peaks area of the Yorkshire Dales, though clearly upland, lacks the dramatic glaciated scenery associated with such areas. There are no corries comparable to those in Snowdonia, for instance, and U-shaped valleys such as Chapel-le-Dale lack the classic form of those found in the Lake District. Depositional features abound in this area, such as the drumlin swarm in Ribblesdale, and roche moutonnées near Giggleswick. The explanation is provided by the fact that the Dales did not generate their own, local glaciers but rather were covered by cold-based ice sheets lacking the intense erosional capabilities of the warm-based cirque and valley glaciers. So a straightforward distinction between upland and lowland can lead to confusion in the field.

The legacy of erosion

In Britain, glaciers came from two principal sources. Ice sheets from Scandinavia reached southwards across the North Sea as far as East Anglia, whilst ice caps from the mountains of western Scotland, the Lake District, Snowdonia and western Ireland spread out. Given their high relief, and plentiful precipitation, erosion was predictably intense in the mountains (Figure 2). However, even though the erosional intensities were lower in the lowland areas, there is still evidence for significant denudation. This evidence is often found in the form of depositional rather than erosional features. Deposited material makes up a large area of lowland Britain and has a distinct source which, contrary to expectations, is often not the highland areas, where deposits are largely sand and gravel, but rather lowland clays. Quite simply, erosion in lowland areas must first have taken place to give rise to these deposits.

Figure 2: Patterns of ice-sheet movement and glacial erosion

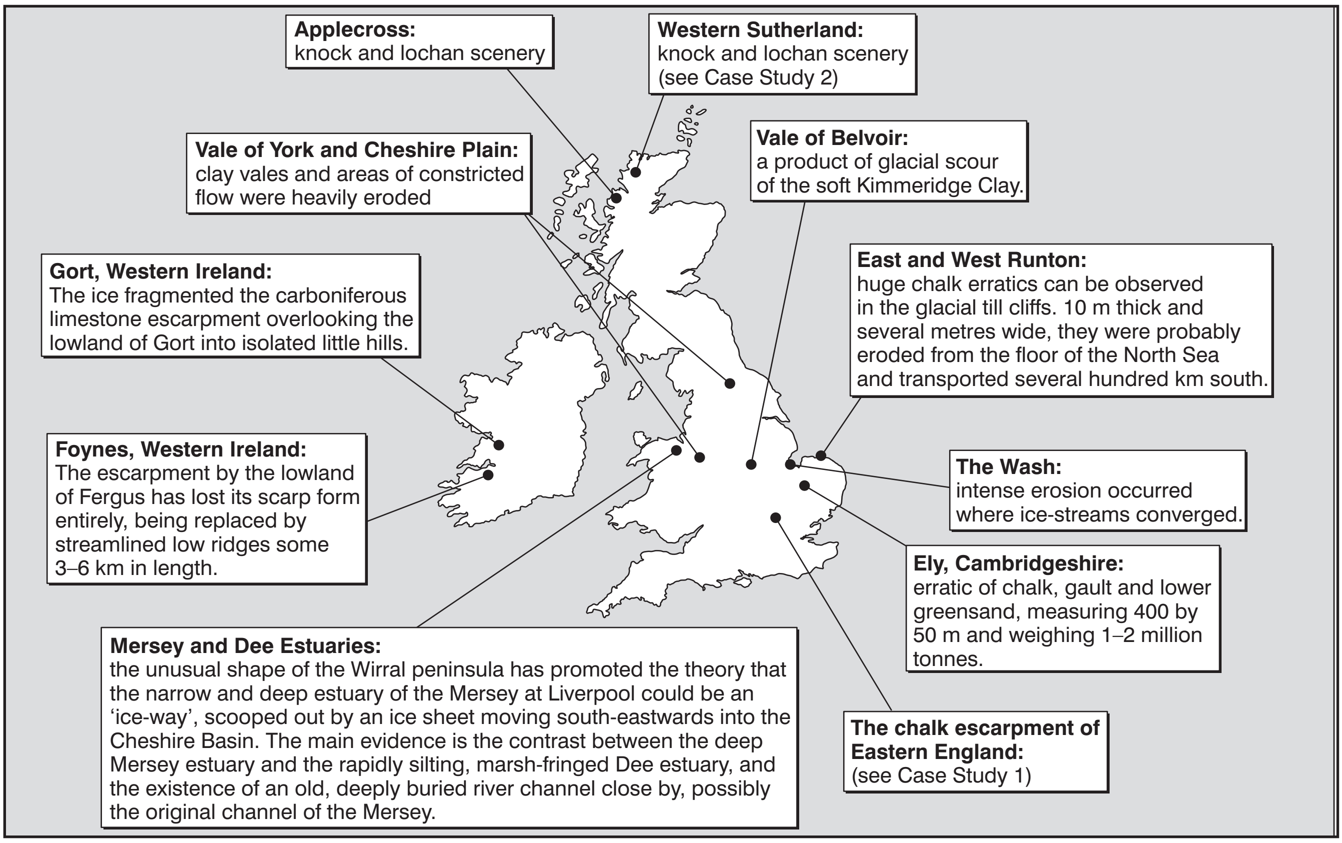


Source: Adapted from Goudie (1990).

Case Study 1 The chalk escarpment of Eastern England

A most convincing indication of the power of lowland glacial erosion is provided by the contrasts along the chalk escarpment shown in Figure 4. To the south stands the Chiltern escarpment, a line of chalk hills essentially untouched by glacial erosion. The hills reach an altitude of 260 m at Coombe Hill near Wendover. As the chalk ridge is traced north-eastwards, however, its crestline becomes progressively lower, broader and less regular, so that just a few kilometres north of the 250 m height at Hitchin, the hills have been lowered by over 100 m. The shape changes from a classic cuesta (escarpment) form to a low and relatively even-crested plateau (Figure 5). Yet not only were height and shape affected. Figure 4 shows the location of the chalk escarpment. The steep scarp slope faces north and the gentler dip slope faces south. Notice how the line of the escarpment changes; from Goring Gap to Ivinghoe Beacon the main scarp stands within 1.5 km of the northern edge of the chalk outcrop, represented by the thick line. However, further north the main escarpment is found progressively farther from the edge of the chalk, and in the Breckland of East Anglia it may be removed by as much as 12–14 km.

Figure 3: Evidence of lowland glacial erosion



The ice has clearly displaced the line of the escarpment.

Over-ridden beyond Luton by former ice sheets, the lowering of the height of the chalk ridge by 100 m is a clear testimony to the power of glacial erosion. By northern East Anglia and the Wash, the chalk has virtually no surface expression at all. Ice has modified the landscape by depositing an enormous quantity of glacial deposits in the form of clays, sands and brick-earths on the remaining chalk of East Anglia; only the Gog Magog Hills near Cambridge and the Newmarket Downs rise above the till sheets, solitary reminders of the chalk's presence beneath the glacial cover.

Case Study 2 Knock and Lochan scenery in Scotland

The Lewisian gneiss (metamorphosed granite) areas of north-west Scotland present possibly the best example of lowland glacial erosion in Britain. These areas were heavily glaciated by ice moving westwards from the higher ground inland which, taking advantage of fault-lines, joints, shatter-belts and other lines of geological weakness, created a landscape of 'confused aspect, with a badly disorganised drainage network' (Small, 1978). Linton (1963) referred to such terrain as knock and lochan topography, from the Scots Gaelic words *cnoc*, meaning 'knoll', and *lochain*, meaning 'small lake'. The location of high and low points reflects the bedrock lithology and structure. Hollows and rock basins occur where joint density is high, or where less resistant rocks outcrop, whereas more resistant rocks underlie knolls (Figure 6).

Western Assynt in Sutherland presents such scenery; the elevation of the area between Stoer in the north and Lochinver in the south (Figure 7) is almost completely below 250 m, and much of it is below 150 m. A detailed examination reveals a landscape of erratics – often red-brown Torridonian sandstone resting on predominantly grey Lewisian gneiss. Desolate lakes linked together by tortuous streams proliferate in a landscape where almost all the hills are bare, rounded, steep-sided hummocks. Here the effect of rock has contributed to the nature of the environment, for the Lewisian gneiss is broken up by dykes running north-west to south-east and faults north-east to south-west, leading to a distinctive rectangular pattern.

Figure 4: The chalk escarpment of Eastern England

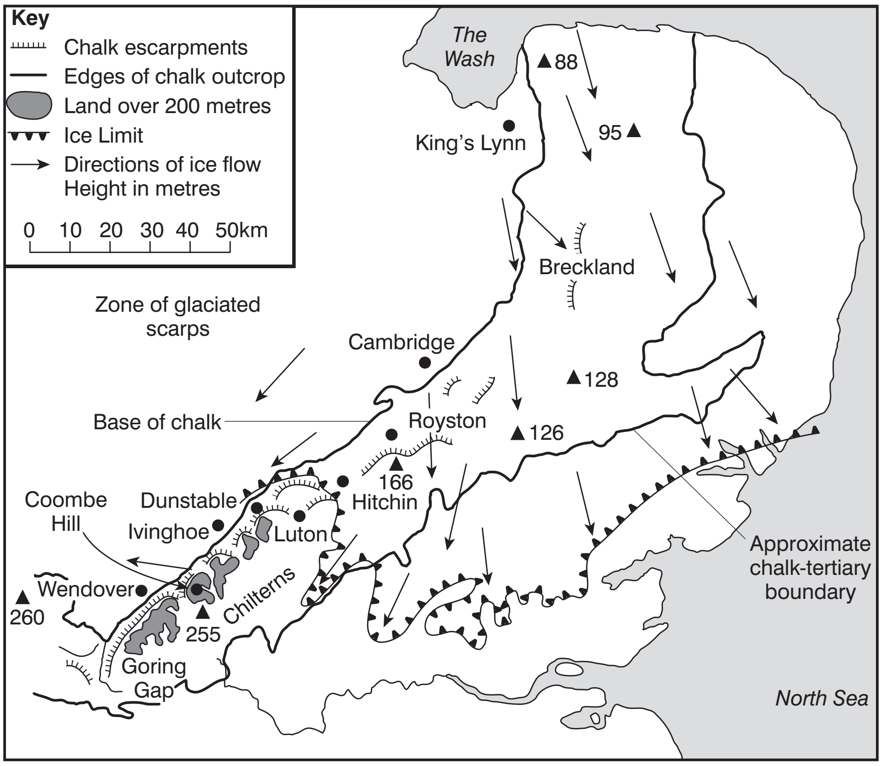
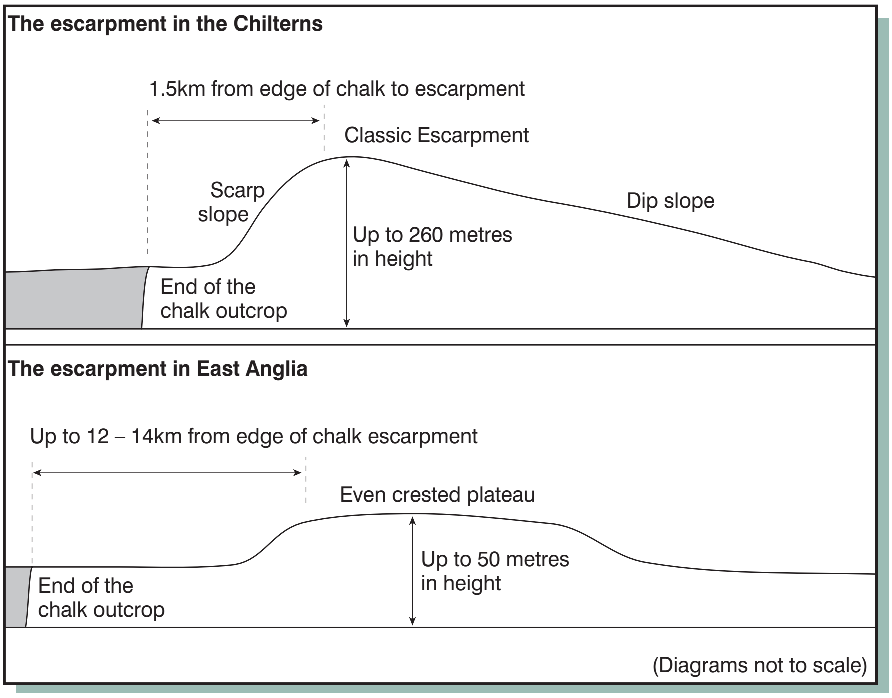


Figure 5: Changes in the escarpment from south-west to north-east



100 km south at Applecross the landscape is repeated; to the west of the glacial breach of Bealach-na-Bà ('pass of the cattle'), the land declines steeply, and open water, bog and bare rock complete the desolate look that Collard (1988) suggests 'must surely make knock and lochan one of Britain's most inhospitable scenes'.

Whalebacks, as their name suggests, have a distinctive rounded shape, whilst rock drumlins are similar in shape to depositional drumlins. Roche moutonnées also exist, characterised by their plucked and angular downstream face. Abrasion has given all of these features a polished, striated surface, and their size can vary from a few metres to kilometres.

Humans and glacially eroded lowlands

To suppose that humans would have little use for eroded lowlands is the obvious initial conclusion. The exception is the chalk escarpment of Eastern England. This is an atypical landscape of lowland erosion, for it was the subsequent deposition of glacial till that today makes it agriculturally a highly productive area. But what of those areas where ice scrapped the ground bare? Here there is little agricultural or pastoral development. Such areas are frequently exposed, windswept and very poorly drained. Vegetation includes coarse grass, bog myrtle and heather (although even this hardy plant does not flourish on gneiss). The treeless expanse of ice-scraped rock, with tiny lochans bestrewn with water lilies and water lobelias, clearly would not respond to attempts at agricultural improvement, a point made clear in the settlement patterns of Sutherland (north west Scotland). The hinterland of Sutherland is uninhabited and the few tiny settlements that do exist hug the coast. Like their Vikings forebears, the crofters of this area have to look to the sea for their livelihood and means of communication.

However, the remoteness and essential wilderness of knock and lochan environments leads to one clear opportunity: their role as a destination for walkers and nature lovers. The Inverpolly National Nature Reserve in Western Assynt (Case Study 2) provides a final example. Founded in 1961, at nearly 11,000 ha it is the second largest reserve in Britain, after the Cairngorms. It is essentially a vast area of heather, grass moorland and bare rock dotted with lochs; with no roads and few tracks, the area is very much a wilderness and receives relatively few visitors for a British nature reserve. Bird life such as golden eagle, buzzard, peregrine and merlin, and mammals including red deer, badger, wildcat, pine marten and otter all exist on the reserve. More than 360 species of plant have been recorded, including many mosses and ferns.

Figure 6: Lowland erosion scenery in West Sutherland (north-west Scotland)

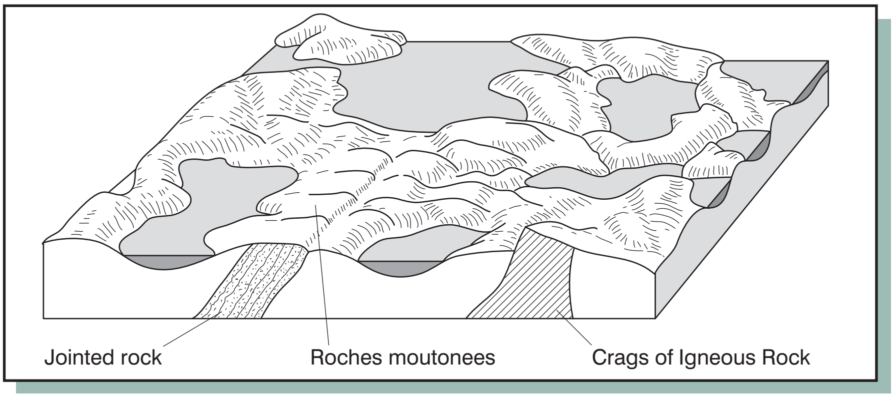
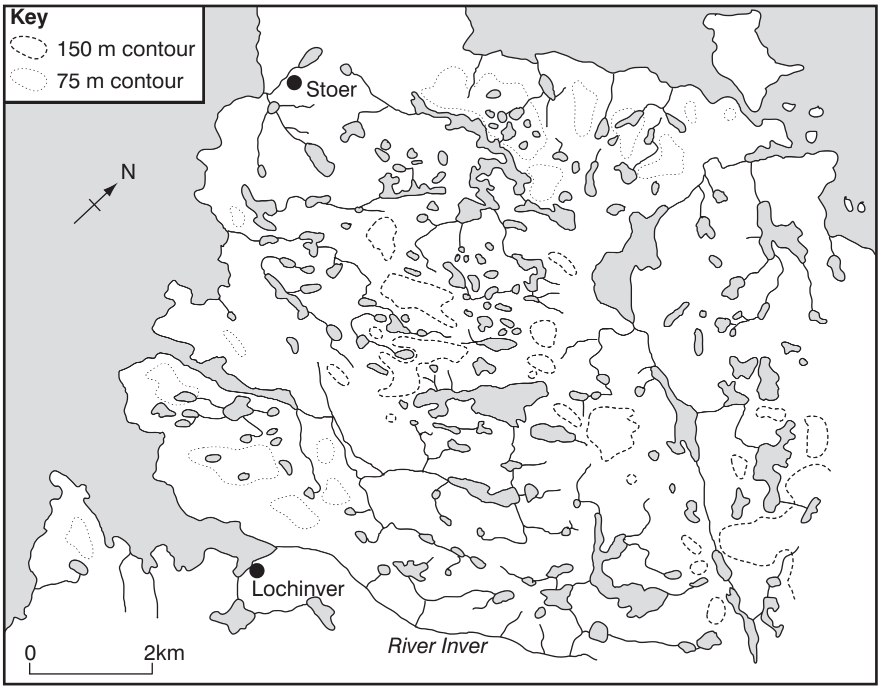


Figure 7: Glaciated Lewisian gneiss country in West Sutherland



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Focus Questions

1. Use Figures 1 and 2 to evaluate the assertion that upland areas are prone to greater glacial erosion than lowland areas. Use an atlas to discover the names of areas showing exceptions to these patterns. What factors could account for these exceptions?

2. Outline the difficulties in gathering evidence to support the existence of lowland glacial erosion.